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Mammals of the Chinati Mountains State Natural Area, Texas

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Abstract

During a survey of the mammals of the Chinati Mountains State Natural Area (CMSNA), 934 individuals of 10 species of bats were captured from nine locations. An additional five species occur elsewhere in the Chinati Mountains (Schmidly 1991) and probably occur on the CMSNA as well. *Antrozous pallidus* was the most abundant bat, followed by *Parastrellus hesperus*, *Myotis velifer*, *Tadarida brasiliensis*, *M. californicus*, *M. thysanodes*, *Mormoops megalophylla*, *Eptesicus fuscus*, *M. volans*, and *Lasiurus cinereus*. A total of 34 species of non-volant mammals were recorded from the CMSNA. Of these, 28 species were documented by 732 voucher specimens, whereas six species were recorded by verifiable sightings or signs. The most commonly trapped rodents included *Chaetodipus nelsoni* (203), *Peromyscus eremicus* (129), *Perognathus flavus* (70), *C. eremicus* (54), and *P. maniculatus* (43).

Key words: bats, Chinati Mountains, mammals, non-volant mammals, vegetation

Introduction

In 1996, the Texas Parks and Wildlife Department (TPWD) acquired a significant piece of property in the Chinati Mountains of western Texas. Not long afterwards, the senior author began discussions with David Riskind, Director of the Natural Resources Program of the State Parks Division of TPWD, about the possibility of conducting surveys for mammals in this poorly known area. Subsequently a formal proposal was submitted to the agency; it was approved for funding in 2003, and the results of the mammal surveys are detailed herein.

Although some work previously had been conducted in the Chinati Mountains, there had been no systematic survey for mammals of the area. Such surveys provide useful comparisons to work conducted by several of the authors in other areas of western Texas, ranging from the Panhandle to the Trans-Pecos region (e. g., Manning et al. 1996, 2006; Mollhagen 1973; Yancey 1997; Yancey and Jones 2000; Yancey et al. 1997, 1998). In particular, the new work is a nice comparative study with work conducted by Yancey (1997) at Big Bend Ranch State Park (BBRSP).

The primary objective was to document the presence of mammals expected to occur within the Chinati Mountains State Natural Area (CMSNA). The specific goals were:

- To document through verifiable data the occurrence of species of mammals of the CMSNA;

- To describe the distribution, relative abundance, and nature of occurrence (e.g., age, breeding status, etc.) of those species occurring on the CMSNA;
- To make some comparisons of the findings at CMSNA with those of BBRSP;
- To provide science-based information on the occurrence of mammals for use by management authorities;
- To identify and mark sites for long-term transects for the basis of long-term monitoring of the mammalian fauna for this region of far western Texas.

HISTORY OF THE CHINATI MOUNTAINS STATE NATURAL AREA

Human occupation of the Chinati Mountains and vicinity dates back to at least 8,000 years ago. Though only one unpublished archeological survey, conducted in 1977, has been undertaken within what is now CMSNA (Greer et al. 1980), this work resulted in the discovery of numerous archeological sites, including caves, rockshelters, and overhangs with archeological deposits, open campsites, lithic scatters, Late Prehistoric Cielo complex sites, possible fortifications, and historic structures. Pictographs (rock paintings) were discovered in two rockshelters and petroglyphs (rock carvings) were identified at one site during this study. The prehistoric sites are primarily divided between those Archaic in age, spanning a period from about 8,000 to 1,200 years ago, and those dating to the Late Prehistoric Tradition from about 1,200 to 470 years ago.

Historic occupation of the Chinati Mountains began with ranching activities as early as the 1830s and 1840s. These activities began in earnest on what would become the CMSNA in 1883 when John (Don Juan) Humphris began sheep ranching in Pinto Canyon. Humphris acquired land to the south of Pinto Canyon while managing the Murphy and Walker Store in Shafter. He operated the ranch until 1909 when it was sold to J. F. Tigner. Tigner again sold the ranch in 1919 to R. L. Stevenson. Stevenson had recently moved to Marfa and was employed at the Marfa National Bank. When he purchased the ranch he named it "Mesquite." He maintained the ranch until his health began to deteriorate in early 1944. Just prior to his death in April of that year, Stevenson sold the 60-section Rancho Mesquite to the White Brothers' ranching firm of Del Rio, Texas. This firm was composed of four brothers, Jim, Hamilton, Russell and Tucker, and they began sheep operations on the Mesquite. In 1978 the property was acquired by Heiner and Phillipa Friedrich. They maintained the ranch with lower numbers of animal units and as a wildlife sanctuary until 1996. At that time they sold 38,137 acres of the ranch to the Richard King Mellon Foundation to be used for the American Land Conservation Program. The Mellon Foundation in turn donated the property to the TPWD.

The other enterprise that took place within the mountains was mining. The first mining activities in the region began in 1869 with J. W. Spencer's operations at Shafter. The Montgomery Mine, located in San Antonio Canyon, within what is now the CMSNA, was opened in 1885 and was an early attempt to mine silver from the area. However, the largest mining activities on the property were undertaken by E. L. Burney. In February 1937, Burney claimed that he had struck the richest vein of silver-bearing ore ever discovered in the Southwest. The location of the strike is on the north side of San Antonio Canyon. He and his associates filed mineral claims for much of the surrounding area. Burney also claimed the discovery of the highest grade of fluorspar ever found in the United States. As a result, the "Texas Mineral Company" was formed. Transportation of materials to and from the mine was a problem and the fluorspar deposit was never exploited. The other substantial mining effort was at the San Antonio Mine, another silver mine. The San Antonio Mine was in operation about the same time as the Burney mine.

VEGETATION OVERVIEW

The CMSNA is located on the western slope of the range, south of Pinto Canyon. Chinati Peak is the highest point in the range (7,730 feet) and is elliptical in shape. The western slopes of the peak are within the CMSNA, although the actual peak is not. The CMSNA lies within the Chihuahuan Biotic Province and the flora and fauna are typical of the northern Chihuahuan Desert.

There has apparently been light grazing pressure within the CMSNA since the late 1970s. The represented plant communities at mid and upper elevations reflect this land-use history and are in good to excellent condition. There are some areas of the park, presumably around holding areas for livestock, where an almost impenetrable thornscrub has developed.

The lower elevations of the CMSNA border the Presidio Bolson, which is cut by the Rio Grande. The plant communities at the lowest elevations found along the western boundary of the park are catclaw-acacia-mesquite associations. In the more highly disturbed areas, the topsoil has been mostly lost leaving very stony or gravelly soils. These areas are most commonly encountered on level terrains and the dominant plant is creosotebush (*Larrea tridentata*) and belongs in the Creosotebush-Mariola Series. In areas of greater relief, an open mixed desert scrub of the Viscid Acacia Series is present. This desert scrub consists of white thorn acacia (*Acacia neovernicosa*) with ocotillo (*Fouquieria splendens*), creosotebush, and lechuguilla (*Agave lecheguilla*). Alluvial terraces are most often covered with dense shrubs consisting of various acacias and mimosas together with thickets of other spiny shrubs like honey mesquite (*Prosopis glandulosa*), althorn (*Koeberlinia spinosa*), and granjeno (*Celtis pallida*). Interspersed among the thorn shrub communities on favorable exposures are desert grasslands dominated by chino grama (*Bouteloua ramosa*).

Arroyos at lower and mid-elevations support dense mixed-desert scrub. Where semi-permanent water is available in lowlands, seepwillow (*Baccharis salicifolia*), four-winged saltbush (*Atriplex canescens*), and burrobrush (*Hymenoclea monogyra*) can be locally abundant. With increasing elevations these drainages are dominated by increasing densities of desert willow (*Chilopsis linearis*), evergreen sumac (*Rhus virens*), little leaf sumac (*Rhus microphylla*), desert olive (*Forestiera angustifolia*), and Apache plume (*Fallugia paradoxa*). Away from these drainages, mid-elevations are dominated by mixed grasslands with sotol (*Dasylirion leiophyllum*), bear grass (*Nolina* sp.), yucca, skeleton-leaf Goldeneye (*Viguiera stenoloba*), with scattered woody plants among the more conspicuous components. Upper elevations gradually give way to an open woodland of gray oak (*Quercus grisea*) woodlands with a significant understory of tall grasses, primarily bull muhly (*Muhlenbergia emersleyi*), and short grasses such as sideoats grama (*Bouteloua curtipendula*) and blue grama (*Bouteloua gracilis*). On south and west facing slopes these grasslands also include sotol, Torrey yucca (*Yucca torreyi*), and Havard agave (*Agave havardiana*). More closed canopy gray oak woodlands are restricted to canyons and other protected areas. Within the heavier gray oak woodlands there are scattered junipers, primarily alligator juniper (*Juniperus deppeana*) and redberry juniper (*J. erythrocarpa*).

There are significant water related natural resources at the site. The most extensive riparian corridor is below Indian Springs and in the adjoining Cienega Arroyo. This narrow riparian corridor includes a near continuous stand of cottonwoods (*Populus fremontii* and *P. deltoides*) and willows (*Salix* sp.) in the Cottonwood-Willow series. There are many other expected riparian species within this woodland, including velvet ash (*Fraxinus velutina*), netleaf hackberry (*Celtis reticulata*), and seepwillow (*Baccharis salicifolia*). Pelillos Canyon also contains permanent water although a riparian woodland is not present. A plant association that might be called a riparian shrubland follows the bottom of the canyon and includes buttonbush (*Cephalanthus occidentalis*), evergreen sumac, and seepwillow. The remaining significant water resource is at a ciénega along the western boundary of the CMSNA. This ciénega is degraded, but recovering, and dominated by saltgrass (*Distichlis spicata*) and alkalai sacaton (*Sporobolus airoides*). The interior of the ciénega is dominated by cattail (*Typha latifolia*) and bulrush *(Scirpus sp.)*. The drainage of the ciénega is lined with a dense mixed desert scrub.

METHODS

Mist-net surveys for bats.—Mist nets were deployed across and around bodies of water and sometimes in perceived flyways to capture bats coming in to drink or feed on insects flying over the water (Kunz and Kurta 1988). In some cases the nets were placed in flyways to night-roosting sites. We tried to net during the new moon when nights are darkest. Net lengths ranged from 3-20 m (9-60 ft) and numbers of nets deployed on any single evening varied from one to five, depending on the area and shape of the body of water. Mist nets were set up shortly before sunset and tended for several hours until activity declined; in some cases nets were observed throughout the night. Nets were never left untended.

Bats were removed from nets immediately following capture and time of capture, species, sex, reproductive condition, and any miscellaneous comments were recorded on standardized data sheets. Bats were generally released unharmed within minutes of capture in the net except for those retained as voucher specimens. Vouchers were deposited in the Mammal Collection of the Natural Science Research Laboratory of the Museum of Texas Tech University. With one exception, common and scientific names for bats are those of Baker et al. (2003). We follow Hoofer et al. (2006) in using *Parastrellus hesperus* for the western pipistrelle or canyon bat.

Each of the sites sampled for bats was given a name as used in this text and the name as used on specimen labels. Coordinates and elevation (in feet) were acquired for each locality with Garmin 12 GPS units set to record Universal Transverse Mercator coordinates (UTMs; NAD27 datum). Elevations were reconciled against USGS quad maps and when there was a discrepancy between sources, values were interpolated from maps. Locality information is as follows, with specimen label names in brackets: Arroyo Cienega, 13 05 41 395E x 33 05 316N, 3161 ft [CMSNA, Arroyo Cienega, 3161']; Boulder Canyon Spring, 13 05 46 355E x 33 16 362N, 4416 ft [CMSNA, Boulder Canyon Spring]; Cinco de Mayo Canyon, 13 05 48 903E x 33 07 557N, 4038 ft [CMSNA, San Antonio Canyon, 4038]; La Cienega, 13 05 41 836E x 33 08 159N, 3500 ft [CMSNA, La Cienega]; Old House, 13 05 47 101E x 33 17 040N, 4340 ft [CMSNA, 13 05 47 101 x 33 17 040]; Pelillos Arroyo Tank 1, 13 05 49 006E x 33 03 000N, 3690 ft [CMSNA, Pelillos Canyon]; Pelillos Arroyo Tank 2, 13 05 46 746E x 33 02 142N, 3465 ft [CMSNA, 13 05 46 746 x 33 02 142]; Pelillos Arroyo Waterfall, 13 05 50 615E x 33 03 265N, 3900 ft [CMSNA, Pelillos Canyon Waterfall]; San Antonio Cabin, 13 05 48 246E x 33 06 073N, 3935 ft [CMSNA, San Antonio Cabin]. In addition, daily journal entries were made when in the field.

Non-volant mammal trapping.—Efforts were made to set Sherman traps, and occasionally snap traps, in as many different habitats as possible. Traps were set in the catclaw-acacia-mesquite associations of the lower elevations, as well as in and near the open woodlands of gray oak and associated plants at the upper elevations. In general, the operating procedure was to place 40 to 50 Sherman traps in a major habitat type. Occasionally, especially on the Sierra Parda, snap traps were placed in the open woodlands and associated grassy areas. On a few occasions, a shotgun was employed.

GPS-based localities were recorded for each trapline location. Locality data (including UTM coordinates) were recorded on the specimen labels, as well as in field journals and field catalogs. For representative samples of specimens, vital tissues were obtained and placed immediately in liquid nitrogen. All tissues and skins and skulls were deposited in the Mammal Collection of the Natural Science Research Laboratory of the Museum of Texas Tech University. Common and scientific names of non-volant mammals follow Baker et al. (2003) except as noted in the text.

Four sites (Upper San Antonio Canyon, San Antonio Cabin, La Cienega, Upper Boulder Canyon) were selected based on species diversity or abundance of species and permanent markers were placed. Detailed directions as to locations and recommendations for the placement of traps or nets were deposited with the supporting agency.

RESULTS

Bats.—During 21 different visits to the CMSNA 934 individuals of 10 species of bats were captured at nine different sites (Fig. 1); three additional sites were sampled with no specimens captured. An additional five species are thought to occur elsewhere in the Chinati Mountains (Schmidly 1991) and probably occur on the CMSNA as well; they are noted below. *Antrozous pallidus* was most abundant with 576 individuals captured, although this total is skewed somewhat by captures of night-roosting bats at San Antonio Cabin. The next most common species was *Parastrellus hesperus* with 177 captures. Captures of other species in rank order are: *Myotis velifer*, 70; *Tadarida brasiliensis*, 63; *M. californicus*, 16; *M. thysanodes*, 11; *Mormoops megalophylla*, 10; *Eptesicus fuscus*, 9; *M. volans* and *Lasiurus cinereus*, 1 each. Of the total captured, 159 bats were retained as voucher specimens to document identifications.

Mormoops megalophylla (Peters 1864)
Ghost-faced Bat

This species is known from Trans-Pecos Texas (Jeff Davis, Brewster, and Presidio counties), including the Chinati Mountains, in the warmer months and from caves in the southern edge of the Edwards Plateau (Schmidly 1991) in the winter. The species appears to reach the northern limits of its distribution in the region. Ten ghost-faced bats were captured during the study. Records of occurrence were from La Cienega and Pelillos Arroyo Waterfall and all were taken between 28 April and 1 September. None of the captures of this unique bat evinced any sign of reproduction. Yancey (1997) examined 30 pregnant females, each with a single embryo, between 29 April and 9 June at BBRSP. Mollhagen (1973) and Schmidly (1991) note previous records from Pinto Canyon, 14mi E Ruidosa.

Leptonycteris nivalis (Saussure 1860)
Greater Long-nosed Bat

Although no greater long-nosed bats were captured during the study, the species is known from the Chinati Mountains in Pinto Canyon (Mollhagen, 1973, Schmidly 1991). An agave stand, suitable for foraging by this nectar-feeding bat, was noted on the upper plateau of the Sierra Parda. This area, and comparable habitat on that part of Chinati Peak in CMSNA, suggests that additional *Leptonycteris* may eventually be taken in the study area.

Myotis californicus (Audubon and Bachman 1842)
California Myotis

This species is relatively common in Trans-Pecos Texas and has been taken in the Chinati Mountains (Schmidly 1991). It is known to winter in the area (Young and Scudday 1975, Schmidly 1991). Winter activity also has been reported for this species at Big Bend National Park (Easterla 1973). A total of 16 individuals of this species was captured at Arroyo Cienega, La Cienega, San Antonio Cabin, Pelillos Arroyo Waterfall, and Pelillos Arroyo Tank 1. There also is a record from Pinto Canyon (Schmidly 1991). This species is difficult to distinguish from *M. ciliolabrum* (Bogan 1974) and voucher specimens are essential in making accurate identifications.

Myotis ciliolabrum (Merriam 1886)
Western Small-footed Myotis

This species is uncommon in Trans-Pecos Texas (e.g., Yancey 1997) and the results at CMSNA support this as none were captured. Schmidly (1991) notes the species is not known from the winter months and is "fairly rare" in Texas. Its preferred habitat may be at elevations in the Trans-Pecos that are higher than those in the Chinati Mountains although there are records from "Chinati Mountains" and the Shafter Mine area on the Livingston Ranch (Schmidly 1991).

Myotis thysanodes Miller 1897
Fringed Myotis

This species is known from the mountainous areas of the Trans-Pecos, including at least four localities in the Chinati Mountains (Pinto Canyon, Upper Pinto Canyon, Chinati Peak, and Upper Wild Horse Canyon; Schmidly 1991). A total of 11 fringed myotis was captured, whereas at Big Bend Ranch State Park Yancey (1997) took only two. A pregnant female was collected on 1 May, as were subadult females on 25 and 27 July. Individuals of this species were noted at La Cienega, San Antonio Cabin, Pelillos Arroyo Waterfall, and Boulder Canyon Spring.

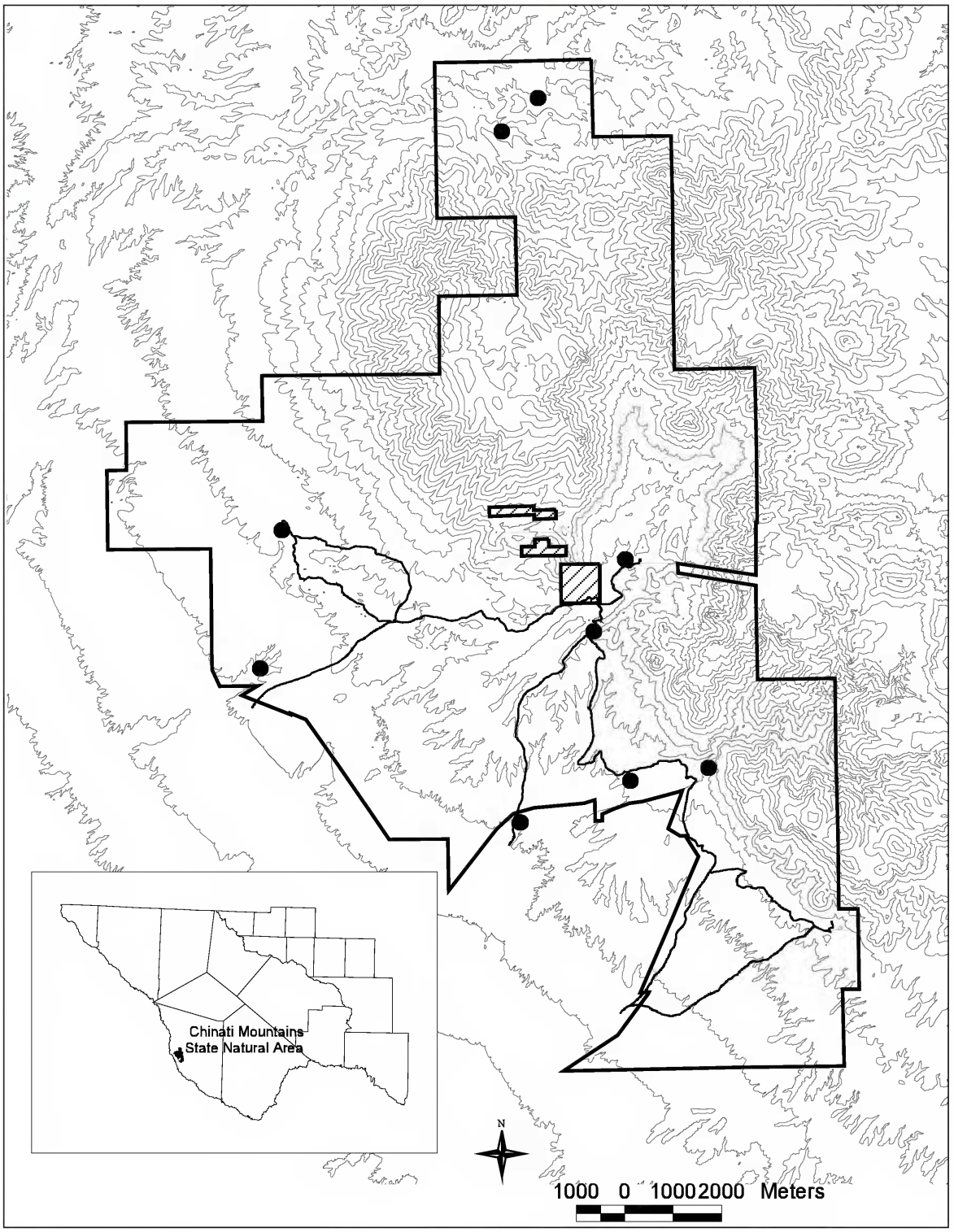

Figure 1. Locations on the Chinati Mountains State Natural Area (CMSNA) where bats were netted. In all figures, hatched areas represent private property within the natural area.

Myotis velifer (J. A. Allen 1890)
Cave Myotis

This large myotis is relatively common in Texas and there are previous records from Dead (Wild) Horse Canyon and "Chinati Mountains" (Schmidly 1991). This was the third most common bat (n = 70) in the CMSNA, but over 60 percent of the individuals were taken at La Cienega on a single night (28 Apr 2004). This species was also documented at San Antonio Cabin. Pregnant, lactating, and subadult bats were captured during the study. These appear to be the first records of pregnant females from the Trans-Pecos (Yancey 1997). One female was taken at San Antonio Cabin, in a net set to capture bats coming to night-roost. Yancey (1997) took 15 individuals at BBRSP.

Myotis volans (H. Allen 1866)
Long-legged Myotis

This species is uncommon in the Trans-Pecos, but there are several previous records from the Chinati Mountains (Pinto Canyon, Chinati Peak, and "Chinati Mts."; Schmidly 1991). Only one individual, an adult female from Pelillos Arroyo Waterfall on 27 April 2004, was documented during the study. This species may be more common in the higher elevations of the Trans-Pecos.

Myotis yumanensis (H. Allen 1864)
Yuma Myotis

The Yuma myotis is a known summer resident of the Trans-Pecos and forages over areas of open water. Although there is a previous record from "Chinati Mountains" (Schmidly 1991), no additional records of this species were obtained. Yancey (1997) took only 6 in his work at BBRSP.

Parastrellus hesperus (H. Allen 1864)
Canyon Bat

This was the second most-common bat we encountered in the CMSNA, with 177 individuals captured. Canyon bats were the most abundant species at BBRSP (123 captured; Yancey 1997). The species is known to be common, if not abundant, in arid areas of the West and there are previous records for the Chinati Mountains (Schmidly 1991). Subadult males and females were captured in addition to pregnant and lactating females. Records of occurrence were La Cienega, Pelillos Arroyo Waterfall, Pelillos Arroyo Tank 1, Cinco de Mayo Canyon, Boulder Canyon Spring, and San Antonio Cabin.

Eptesicus fuscus (Palisot de Beauvois 1796)
Big Brown Bat

Previous records for big brown bats in the Chinati Mountains include specimens from Pinto Canyon, "Chinati Mts.", Wild Horse Canyon, and Livingston Ranch (Schmidly 1991). Nine big brown bats were recorded with individuals captured at La Cienega, Pelillos Arroyo Tank 1, and Boulder Canyon Spring. All individuals were non-reproductive adults although we suspect the species breeds in the area. Yancey (1997) found evidence of reproduction at BBRSP, where this species was the fourth most abundant in captures.

Lasiurus borealis (Muller 1776)
Eastern Red Bat

The distribution and abundance of this species is poorly known in the Trans-Pecos. Schmidly (1991) cites a record from 14 mi E Ruidosa in the Chinati Mountains as well as scattered records from elsewhere in the area. *Lasiurus blossevillii* also occurs in the Trans-Pecos (Genoways and Baker 1988). No red bats were captured during this study of the area.

Lasiurus cinereus (Palisot de Beauvois 1796)
Hoary Bat

This migratory species is known from the Shely Ranch and Pinto Canyon in the Chinati Mountains. Females migrate through the area in spring and fall whereas males first appear in spring and remain throughout the summer (Schmidly 1991, Yancey 1997). One female hoary bat was collected from the Pelillos Arroyo Waterfall on 27 April, a date that suggests the individual may have been migrating to the north (Cryan 2003).

Corynorhinus townsendii (Cooper 1837)
Townsends Big-eared Bat

Townsend's big-eared bat is known from the Chinati Mountains on the basis of captures from Pinto

Canyon, Chinati Rancho, and Shafter Mine (Schmidly 1991). However, none were captured during this study. Yancey (1997) took 11 at BBRSP.

Antrozous pallidus (LeConte 1856)
Pallid Bat

The pallid bat, common in the Trans Pecos, was the most commonly-captured species at CMSNA (n = 576) and they also night-roosted at several sites. At San Antonio Cabin they were captured in large numbers as they came into night roost under the eaves of the porch and there was evidence of roosting at virtually all the cabins and kiosks on the property. Individuals in all phases of reproduction were captured, including scrotal and subadult males and pregnant, lactating, post-lactating, and subadult females. Records of occurrence came from San Antonio Cabin, La Cienega, Pelillos Arroyo Waterfall, Pelillos Arroyo tanks 1 and 2, Cinco de Mayo Canyon, Old House, and Boulder Canyon Spring. Previous records in the region are from Pinto Canyon, "Chinati Mts.", and Chinati Ranch (Schmidly 1991). This species appears to be somewhat less common at BBRSP (Yancey 1997).

Tadarida brasiliensis (Geoffroy Saint-Hilaire 1824)
Mexican Free-tailed Bat

Schmidly (1991) notes that this species is the most common bat in Texas and that it is abundant statewide. Population numbers are undoubtedly in the millions. Populations of this species in the Trans-Pecos are believed to be migratory. No indication of reproduction was noted in the 63 adults captured. Yancey (1997) captured 62 individuals at BBRSP, where he found pregnant and lactating females, and one volant young in early August. Records of occurrence were made from La Cienega, San Antonio Cabin, and Pelillos Arroyo Waterfall. Schmidly (1991) lists previous records for the species from the mountains.

Non-volant mammals.—A total of 34 species of non-volant mammals was recorded from the Chinati Mountains State Natural Area. Of these, 28 species were documented by 732 voucher specimens, whereas six species were recorded by verifiable sightings or other signs. Mammal collection sites are depicted in Figure 2. The most commonly trapped rodents included *Chaetodipus nelsoni*, 203; *Peromyscus eremicus*, 129; *Perognathus flavus*, 70; *C. eremicus*, 54; and *P. maniculatus*, 43.

Sylvilagus audubonii (Baird 1858)
Desert Cottontail

This species was observed in numerous places at several elevations, but all five specimens were obtained only in San Antonio Canyon (Fig. 3). In the bottom of the canyon, vegetation is dense, with thick ground cover. The animals seemed unusually wary in comparison to other species observed elsewhere. It has been implied by Ruedas (1998) and others that *S. robustus* may occur in the Chinati Mountains. However, we are familiar with *S. robustus* in the Davis Mountains and in the Maderas del Carmen range of Coahuila, Mexico; none was seen anywhere on the CMSNA. *Sylvilagus audubonii* was sighted throughout BBRSP (Yancey, 1997)

Lepus californicus (Gray 1837)
Black-tailed Jackrabbit

These animals were observed frequently in the evening, especially in the vicinity of San Antonio Cabin (Fig. 3). Also, they were seen on the roads almost everywhere at night. The animal collected was a very large female. These animals were seen throughout BBRSP, except along the Rio Grande (Yancey, 1997).

Ammospermophilus interpres (Merriam 1890)
Texas Antelope Squirrel

These animals seemed especially wary; they were always sighted when on the run. Attempts to trap them were unsuccessful, even when traps were placed at the entrance to a burrow where an animal was seen. This species was seen and heard in numerous areas of the CMSNA. Finally, one was shot as it ran along the road in the bottom of San Antonio Canyon (Fig. 4). Yancey (1997) listed three specimens, but stated that the animals were seen frequently throughout much of BBRSP.

For the following two genera, we follow Helgen et al. (2009) for the generic names.

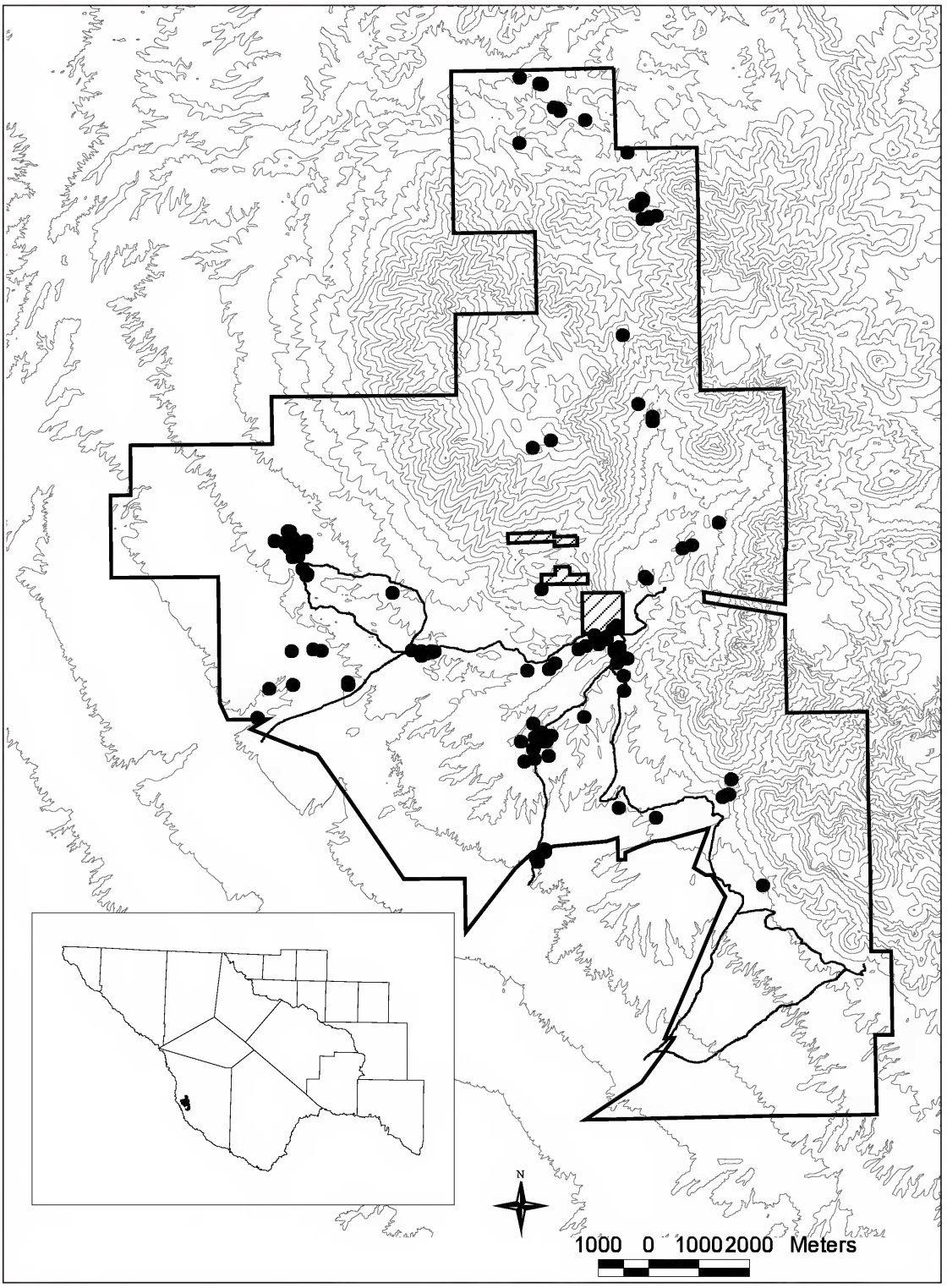

Figure 2. Locations on the CMSNA where non-volant mammals were trapped.

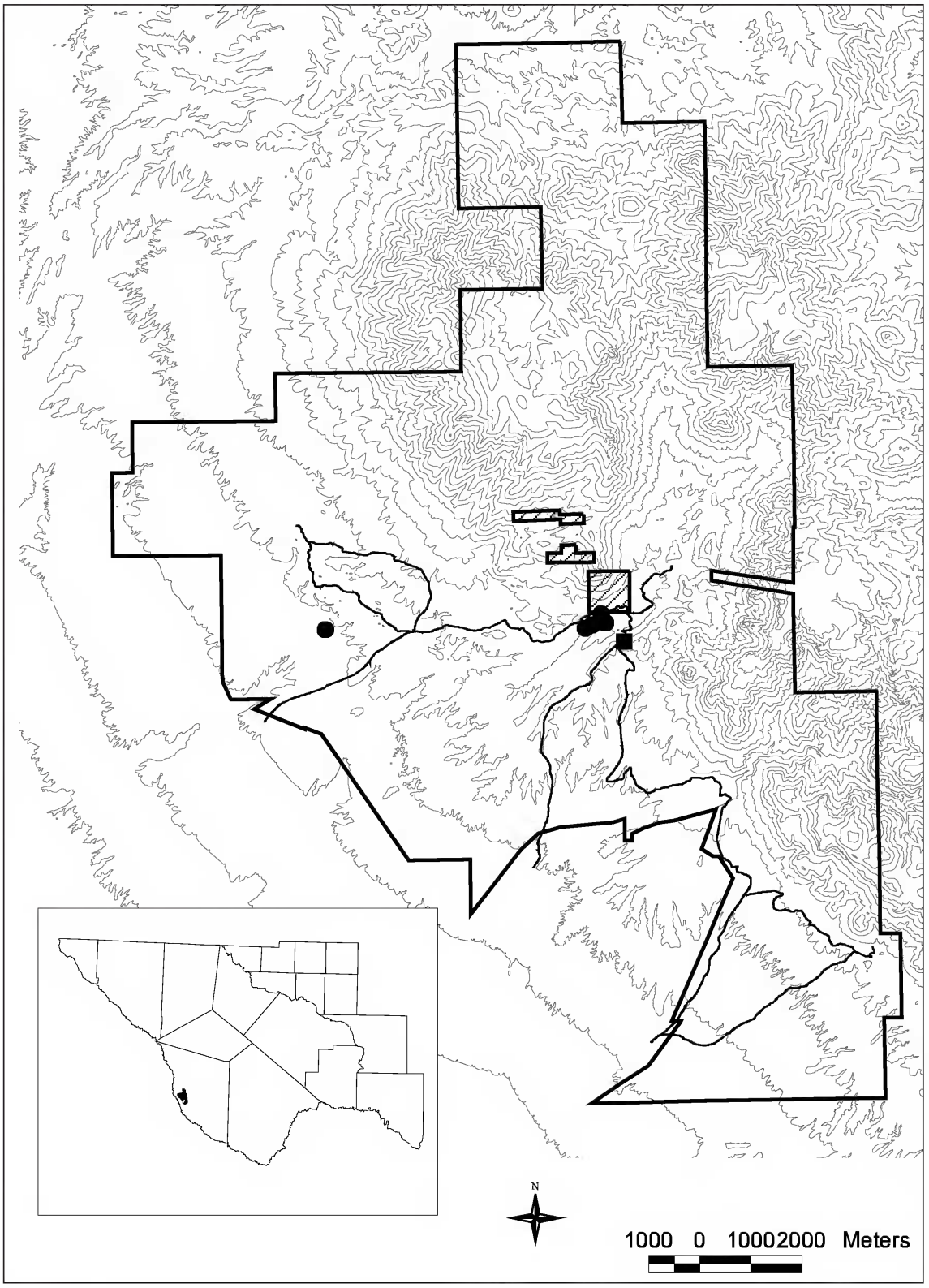

Figure 3. Locations on the CMSNA where *Sylvilagus audubonii* (circles) and *Lepus californicus* (squares) were taken.

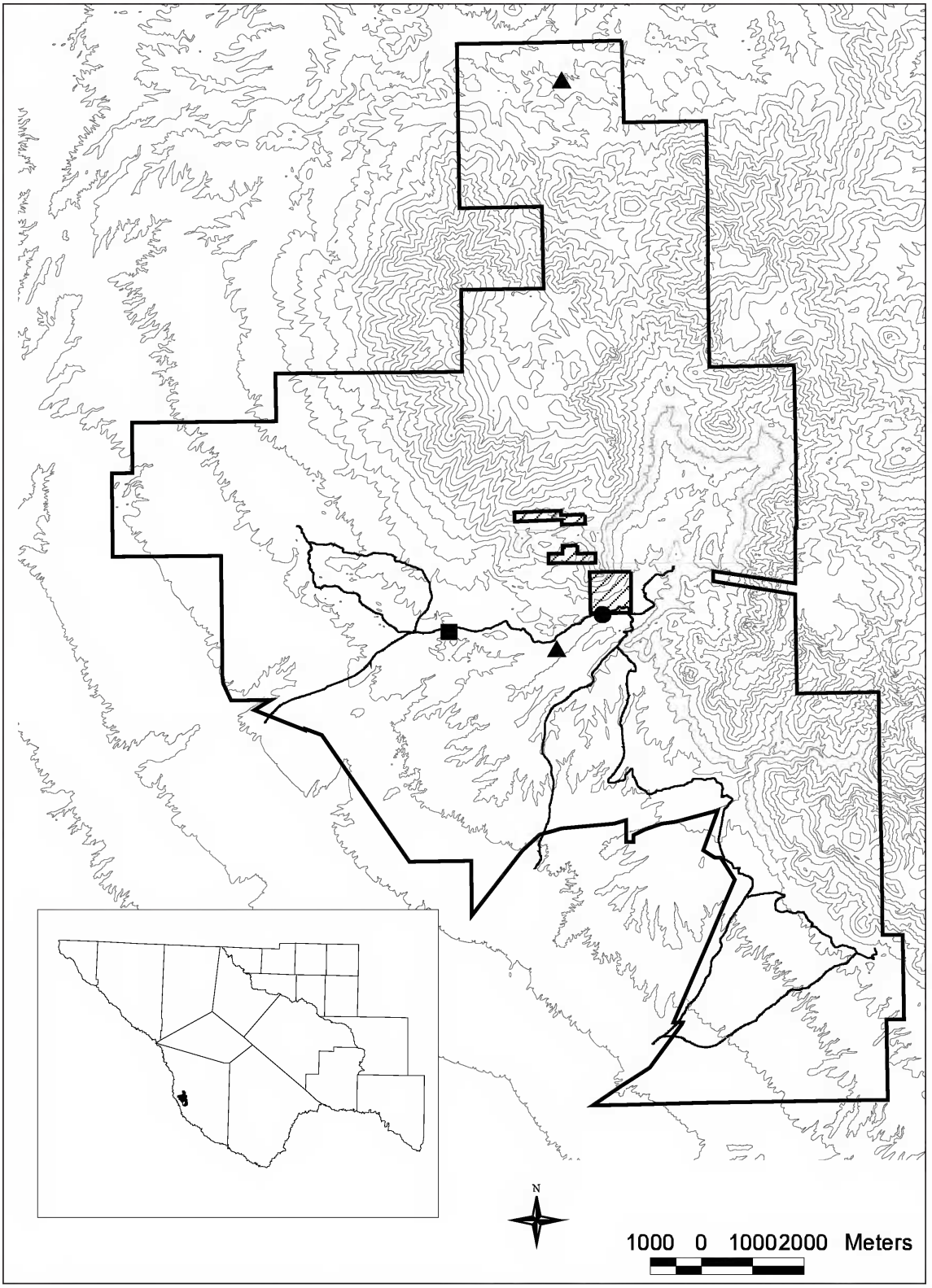

Figure 4. Locations on the CMSNA where *Ammospermophilus interpres* (circles), *Xerospermophilus spilosoma* (squares), and *Otospermophilus variegatus* (triangles) were trapped.

Xerospermophilus spilosoma Bennett 1833
Spotted Ground Squirrel

As with the previous species, these animals were always observed on the run until they entered a burrow. One was caught finally in a trap set at the entrance to a burrow where an animal had just entered (Fig. 4). These animals are known to be shy (Davis and Schmidly 1994). Given the low numbers of sightings, this species should be considered as uncommon in the CMSNA, as well as in BBRSP (Yancey 1997).

Otospermophilus variegatus (Erxleben 1777)
Rock Squirrel

As with the other squirrels at the CMSNA, rock squirrels are very wary, making them difficult to observe and collect. All of these squirrels that were observed were in associations of scrub vegetation and rocky areas, as the common name implies. Two were taken in Boulder Canyon near the cabin; one was taken in the bottom of San Antonio Canyon (Fig. 4). They may be more common at the CMSNA than the frequency of encounters indicates (n = 3). In BBRSP Yancey (1997) made numerous observations, but was able to obtain a single specimen.

Cratogeomys castanops (Baird 1852)
Yellow-faced Pocket Gopher

Two specimens were obtained from the deep soils adjacent to San Antonio Cabin (Fig. 5). Although mounds presumably made by pocket gophers were seen on several occasions, no additional specimens were collected. Yancey (1997) had four specimens from BBRSP.

Perognathus flavus (Baird 1855
Silky Pocket Mouse

Perognathus flavus was the third most abundant rodent at CMSNA. A total of 70 specimens was collected at 17 localities spread across several elevations (Fig. 5). It was the fourth most abundant rodent at BBRSP (Yancey 1997). This rodent seemed especially common in the vicinity of Hilltop Cabin. Schmidly (1977) thought that this species was one of the most common rodents in the Trans-Pecos. See Coyner et al. (2010) for a discussion of the relationships of this species.

Chaetodipus eremicus (Mearns 1898)
Chihuahuan Desert Pocket Mouse

This species was the fourth most common rodent at CMSNA; 54 animals were captured at 17 places spread across several elevations (Fig 6). *Chaetodipus eremicus* was the most frequently encountered rodent at BBRSP (Yancey 1997). At the CMSNA, this species was encountered in varying numbers at all elevations and in most plant communities. However, the species seemed to show a preference for desert scrub, a situation similar to that at BBRSP, where localities were scattered across the Park (Yancey 1997). Manning et al. (1996) discussed some of the relationships of this species and *C. nelsoni*.

Chaetodipus intermedius Merriam 1889
Rock Pocket Mouse

This mouse is relatively uncommon, and was captured at scattered localities dominated mostly by creosote shrubs at CMSNA. It was much less common (n = 14) than the other two species of *Chaetodipus* (Fig. 7). At BBRSP, the rock pocket mouse was found only in the western fourth of the area (Yancey 1997).

Chaetodipus nelsoni Merriam 1894
Nelson's Pocket Mouse

This species was the most common rodent at the CMSNA (n = 203). Except for riparian areas, this mouse was found in all habitats at all elevations sampled (Fig. 8). This species apparently is the most common of the pocket mice within its geographic range (Best 1994). At BBRSP, it was found in numerous localities throughout most of the area (Yancey 1997).

Dipodomys merriami Mearns 1890
Merriam's Kangaroo Rat

This species was obtained in small numbers (2-3/night) at the lower elevations throughout the area (n = 47). It was associated mostly with acacia-catclaw-mesquite habitats, as well as in areas dominated by creosotebush (Fig. 9). Although mostly a nocturnal

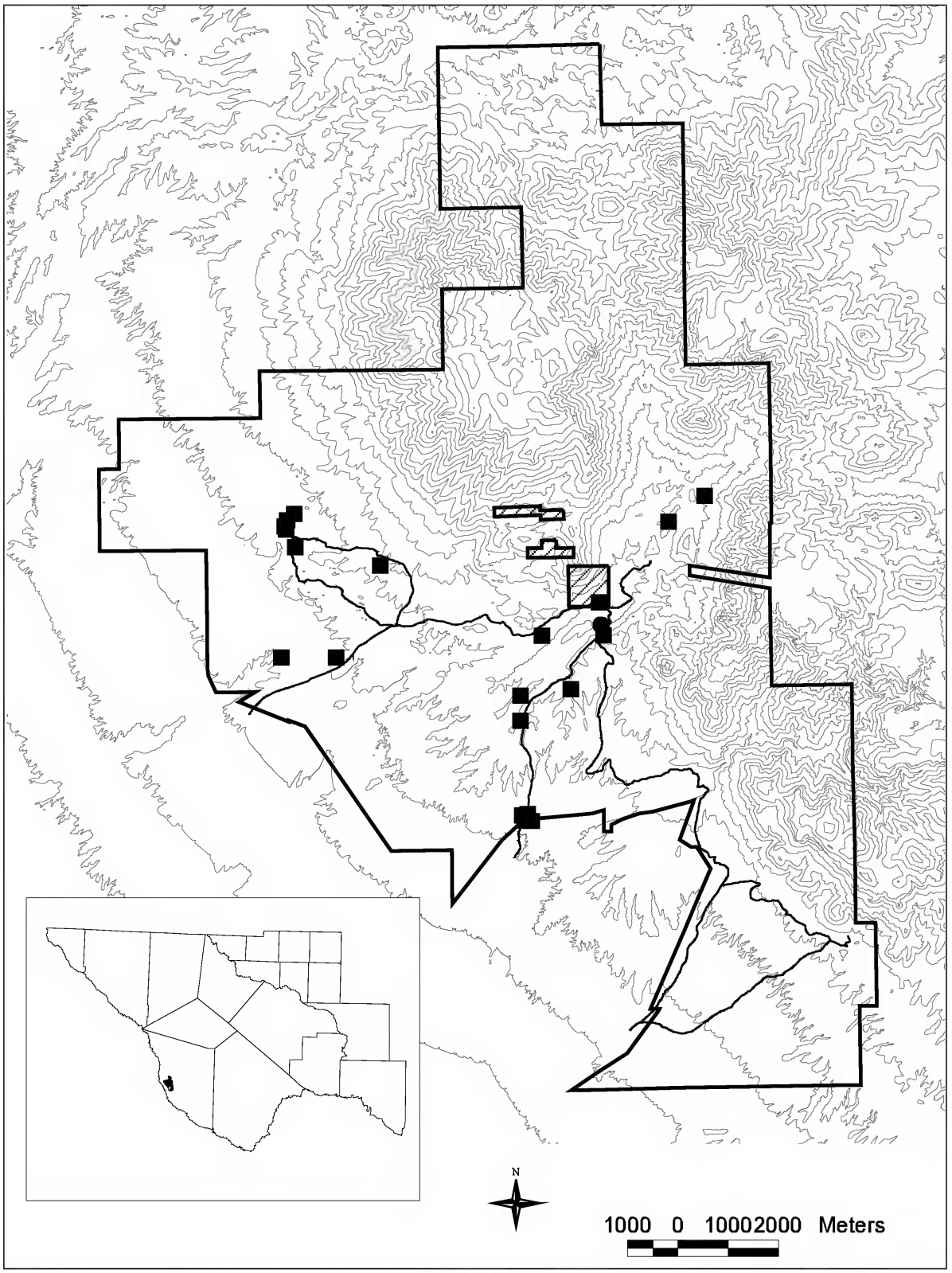

Figure 5. Locations on the CMSNA where *Cratogeomys castanops* (circles) and *Perognathus flavus* (squares) were trapped.

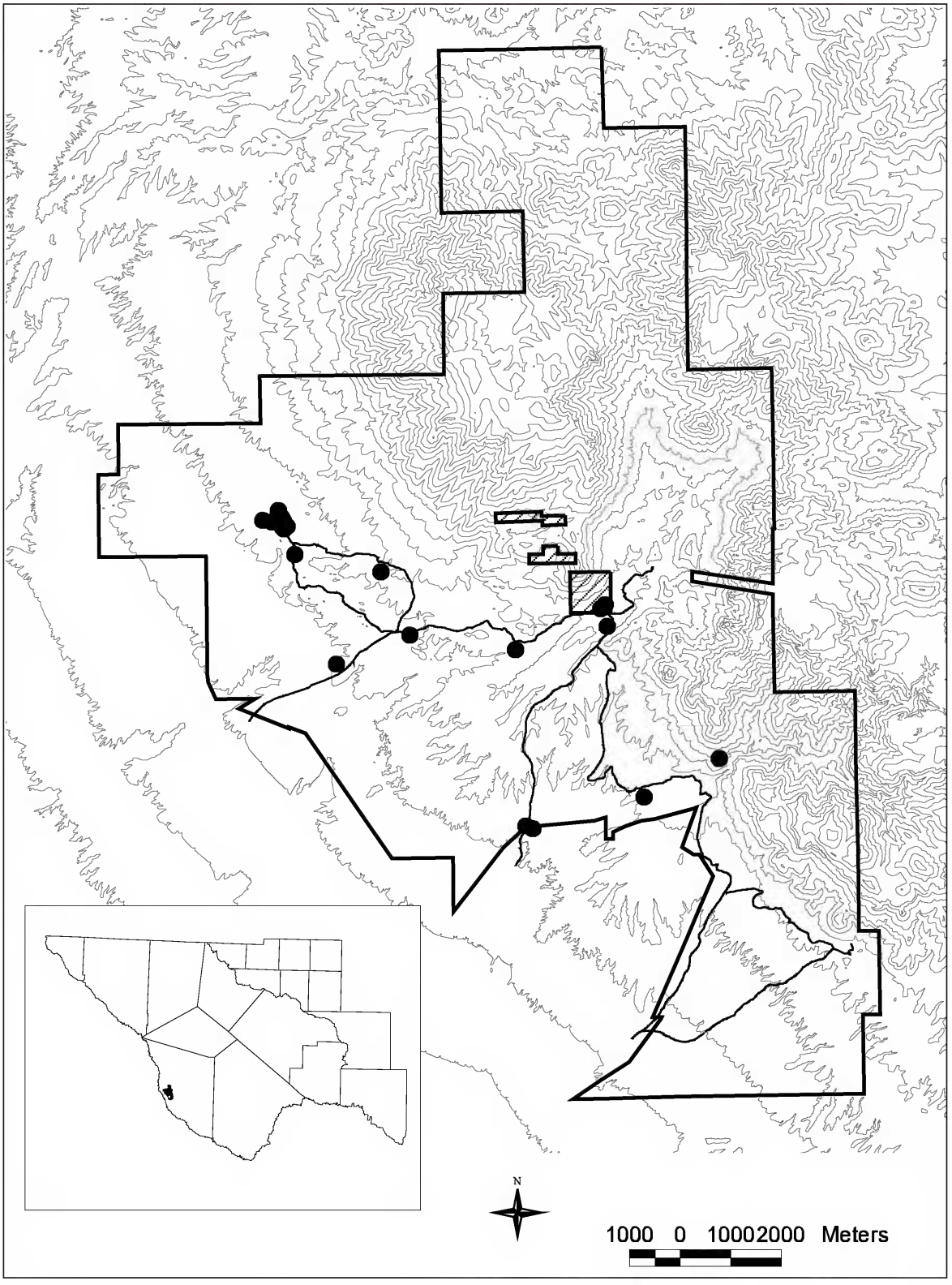

Figure 6. Locations on the CMSNA where *Chaetodipus eremicus* was trapped.

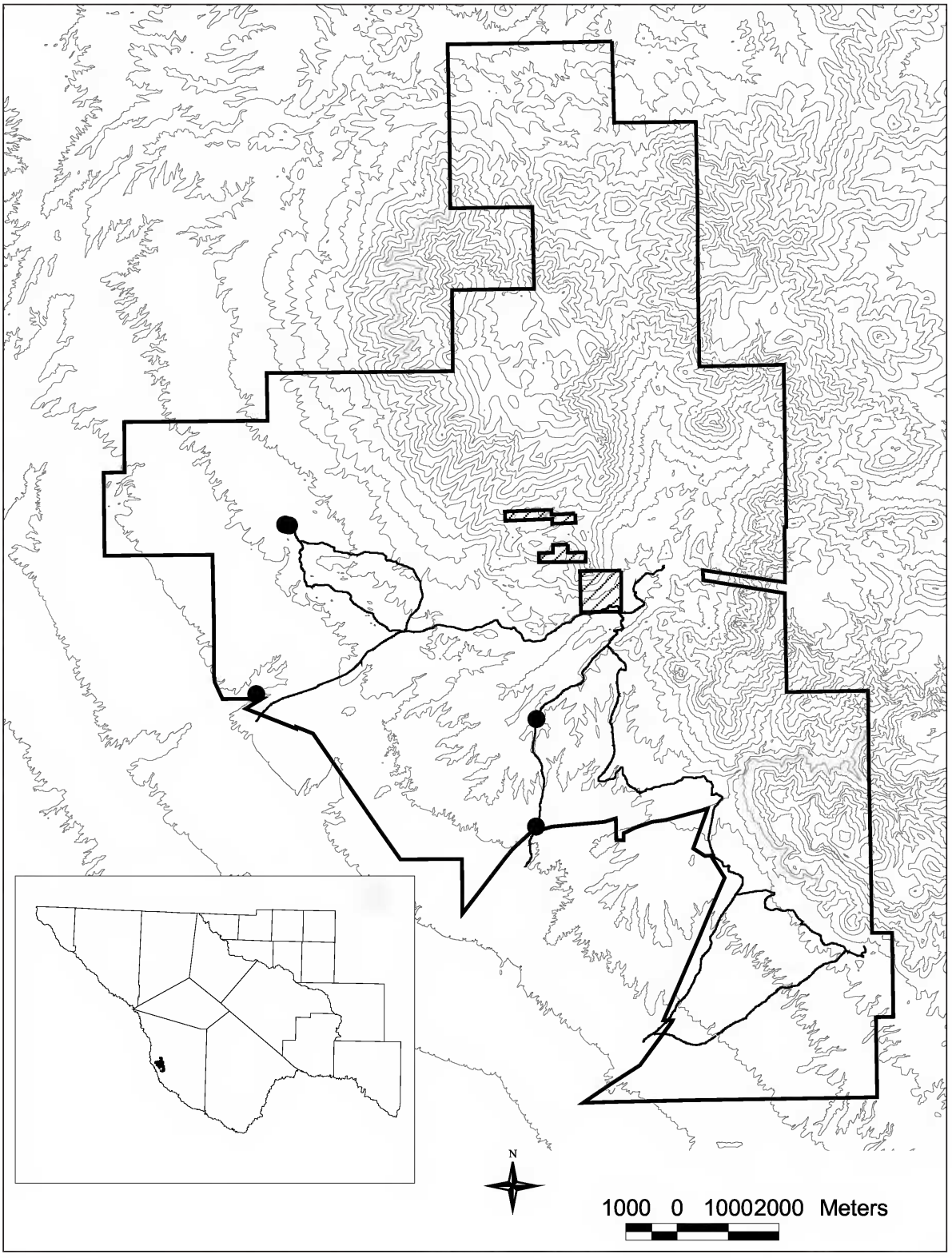

Figure 7. Locations on the CMSNA where *Chaetodipus intermedius* was trapped.

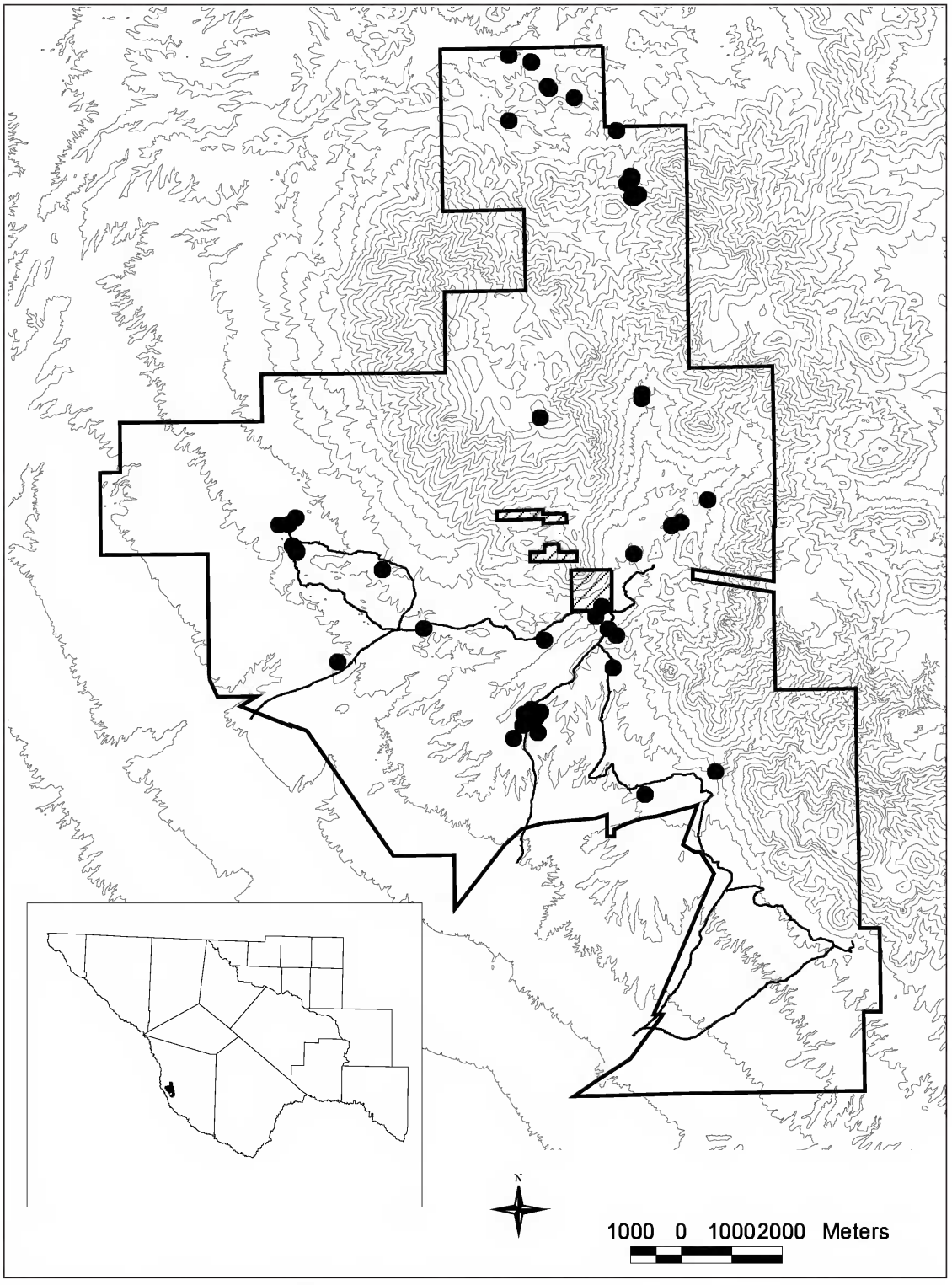

Figure 8. Locations on the CMSNA where *Chaetodipus nelsoni* was trapped.

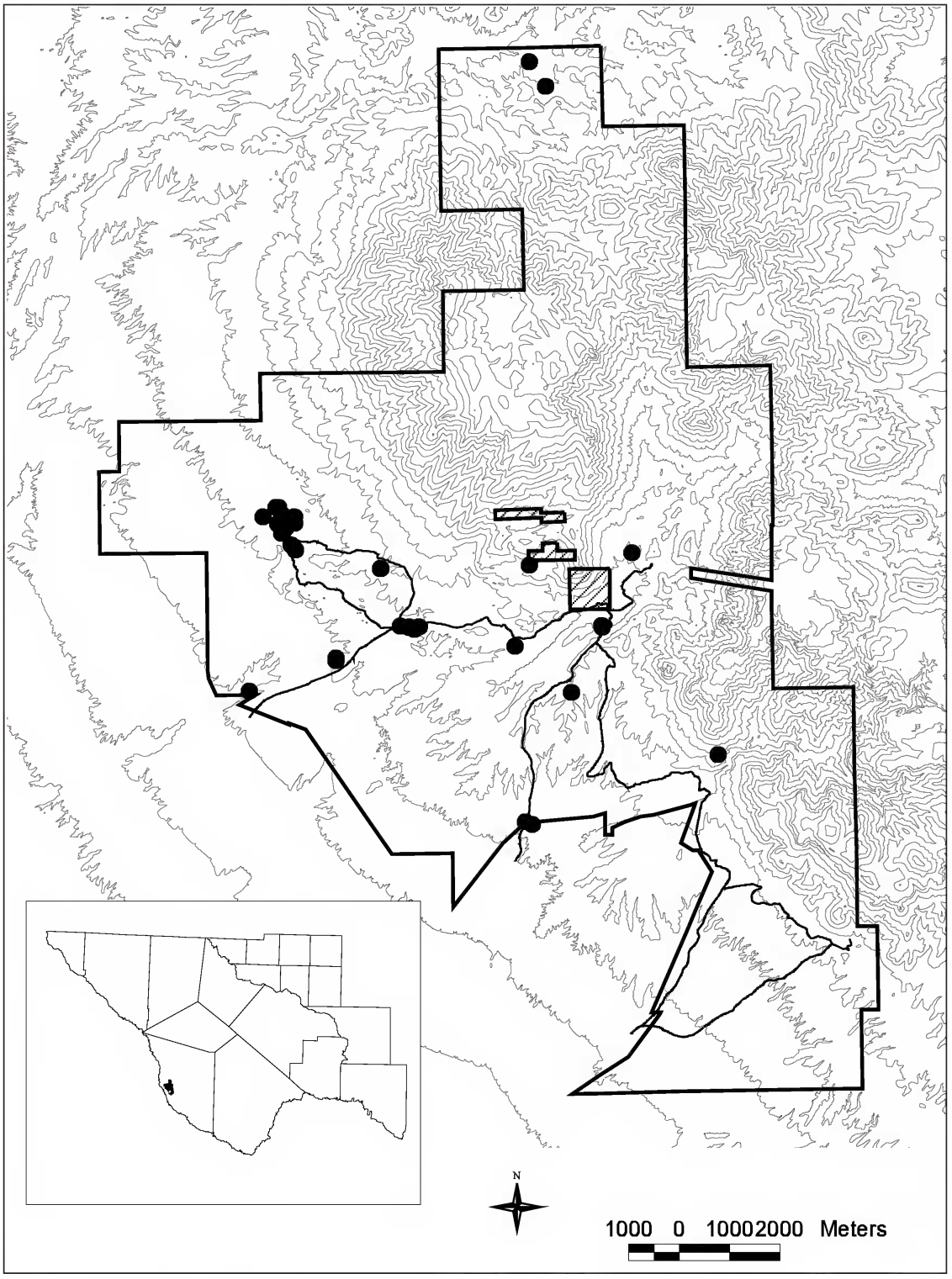

Figure 9. Locations on the CMSNA where *Dipodomys merriami* was trapped.

mammal, on several occasions it was seen during the day in the western part of the CMSNA. At BBNP, *D. merriami* was the second most common rodent (Yancey 1997).

Reithrodontomys fulvescens J. A. Allen 1894
Fulvous Harvest Mouse

This mouse was encountered in San Antonio Canyon, La Cienega, and Boulder Canyon (Fig. 10). It seemingly occurred in association with riparian vegetation. *Reithrodontomys fulvescens* was the least common (n = 17) of the harvest mice at the CMSNA. Yancey (1997) reported eight specimens from four localities at BBRSP.

Reithrodontomys megalotis (Baird 1858)
Western Harvest Mouse

This species was the most common (n = 42) of the harvest mice at the CMSNA. This mouse occurred at lower elevations, and was most common in the area around La Cienega, where 20 were captured in one night (Fig. 10). Yancey (1997) regarded this species as uncommon at BBRSP.

Peromyscus boylii (Baird 1855)
Brush Mouse

This mouse was found at the upper elevations either in or adjacent to the gray oak woodlands (Fig. 11). The species was encountered in areas with a dense understory of tall grasses (n = 30). Yancey (1997) listed a single specimen from a rocky hillside above the Rio Grande in BBRSP.

Peromyscus eremicus (Baird 1858)
Cactus Mouse

Peromyscus eremicus was the second most common mammal (n = 129) at tthe CMSNA. It is of interest that 30 were caught in San Antonio Cabin during the course of this study. Otherwise, this species was captured in all habitats at all elevations in the area (Fig. 12). This mouse was the third most commonly captured rodent at BBRSP (Yancey, 1997). Manning et al. (2006) analyzed specimens from BBRSP and compared them with specimens from northwestern Big Bend National Park; there were no significant morphological differences between sexes, and slight differences between the two populations.

Peromyscus leucopus (Rafinesque 1818)
White-footed Mouse

This species was trapped in small numbers (n = 17) from a total of six localities within the CMSNA (Fig. 11). It was caught in all habitats at these elevations. Yancey (1997) reported 69 specimens from scattered localities at BBRSP. He noted a preference for riparian woodland, but he also caught them in desert scrub and desert grassland.

Peromyscus maniculatus (Wagner 1845)
Deer Mouse

This species was the second most common (n = 43) of the *Peromyscus* at the CMSNA. Although taken at a total of 10 localities (Fig. 13), many of the specimens were encountered adjacent to La Cienega. Yancey (1997) reported the species from scattered localities throughout BBRSP.

Peromyscus pectoralis Osgood 1904
White-ankled Mouse

This mouse was the least abundant of the *Peromyscus* obtained at the CMSNA (n = 5). The specimens were taken in dense grass near the gray oak woodland, as well as at a lower elevation in Boulder Canyon (Fig. 13). Yancey (1997) found this species relatively common at BBRSP.

Onychomys arenicola Mearns 1896
Mearns' Grasshopper Mouse

This species was one of the more uncommon (n = 2) of the rodents at the CMSNA. Both mice were obtained at a single place in the lower portion of Boulder Canyon in lowland desert scrub (Fig. 13). Yancey (1997) reported that this rodent was uncommon in BBRSP.

Sigmodon hispidus Say and Ord 1825
Hispid Cotton Rat

Like the previous species, this rat was one of the more uncommon species of mammals (n = 2) at

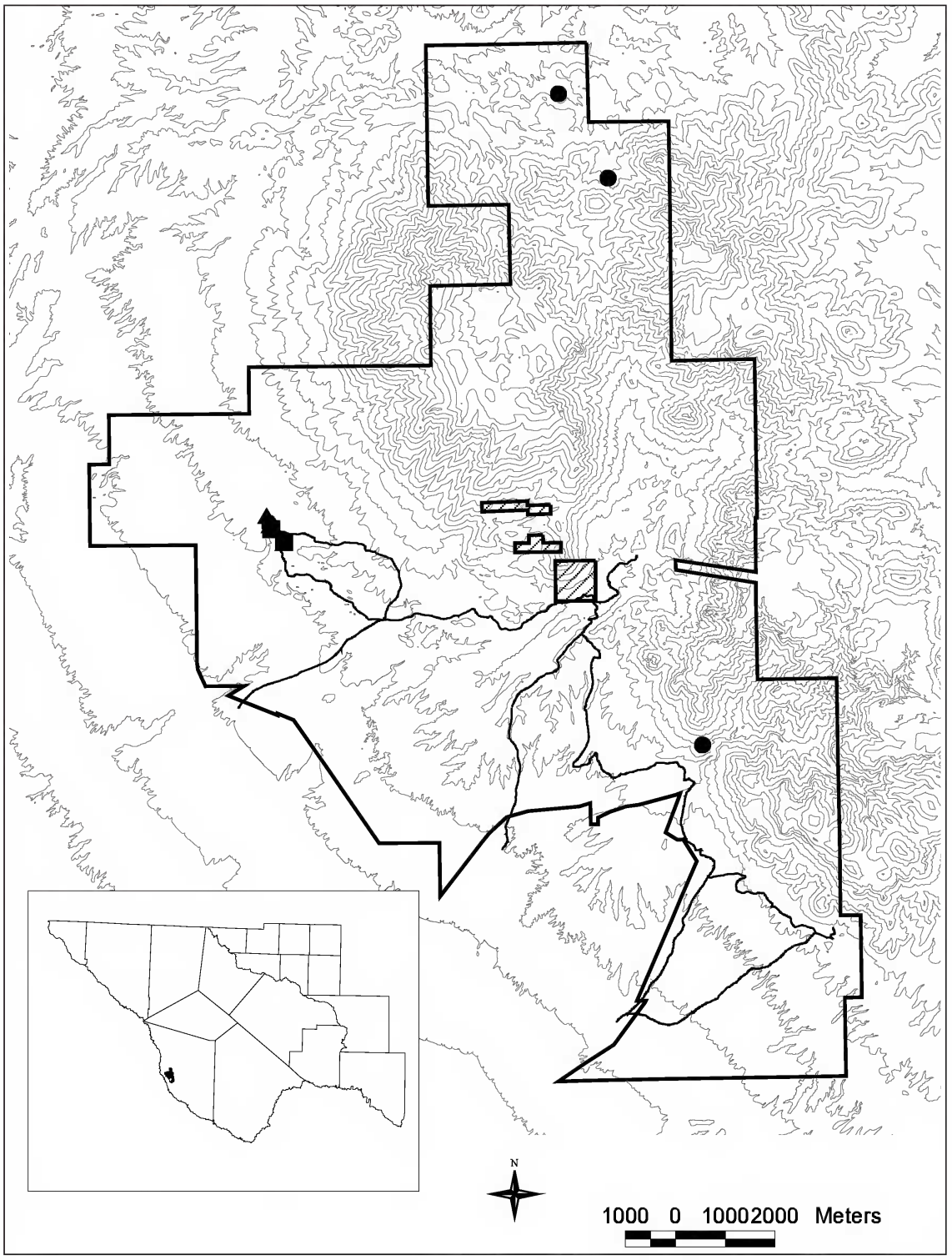

Figure 10. Locations on the CMSNA where *Reithrodontomys fulvescens* (circles), *Reithrodontomys megalotis* (triangles), or both (squares) were trapped.

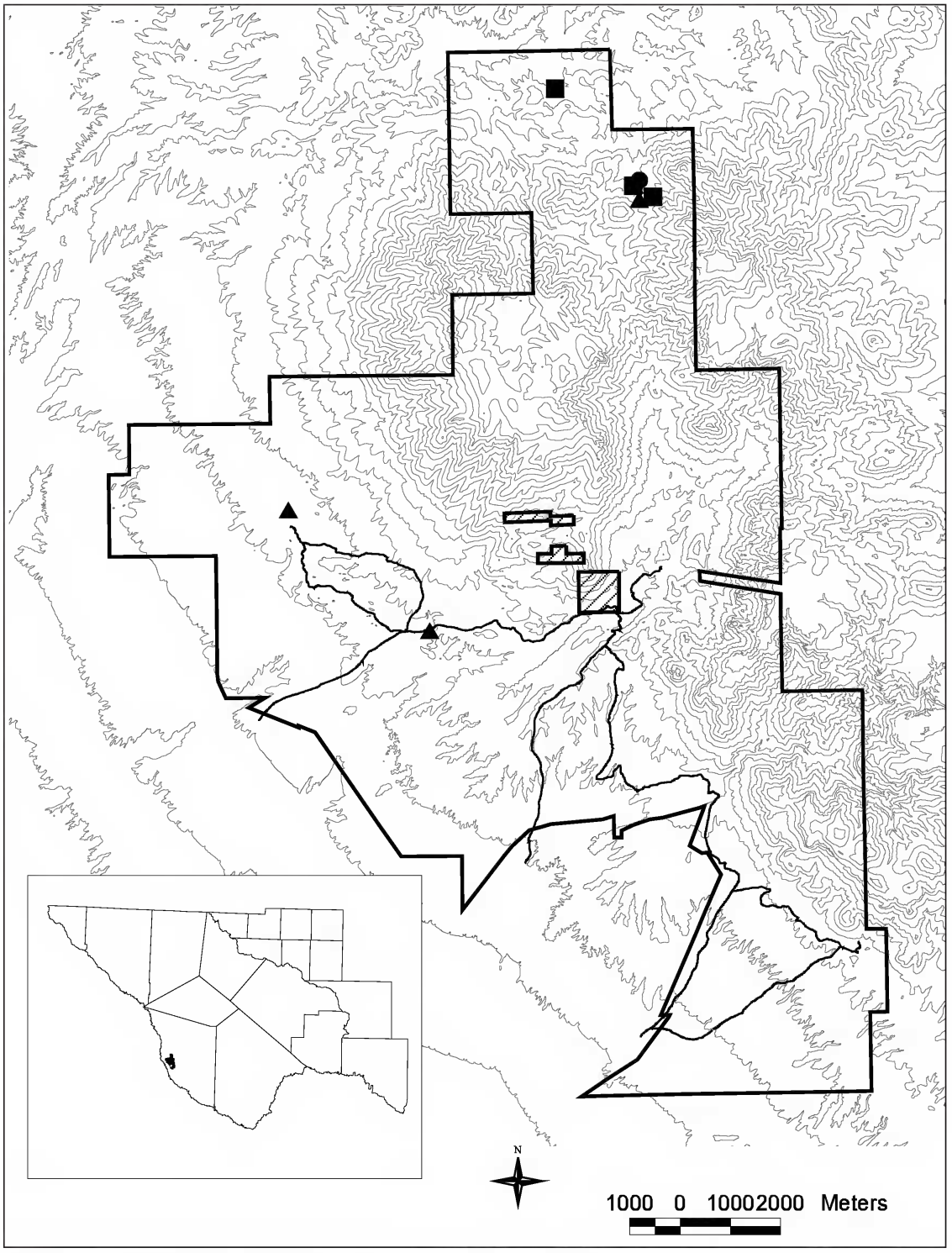

Figure 11. Locations on the CMSNA where *Peromyscus boylii* (circles), *Peromyscus leucopus* (triangles), or both (squares) were trapped.

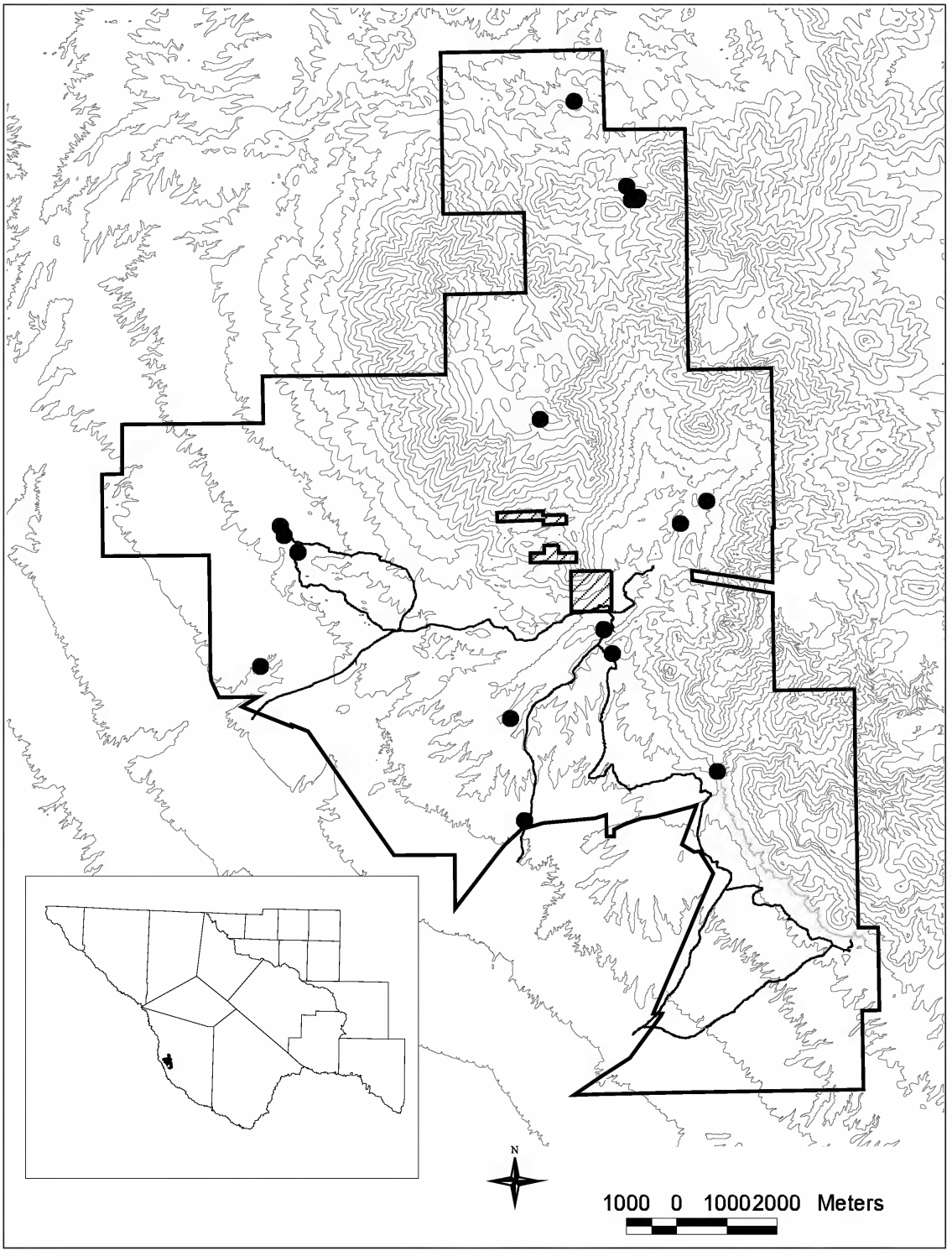

Figure 12. Locations on the CMSNA where *Peromyscus eremicus* was trapped.

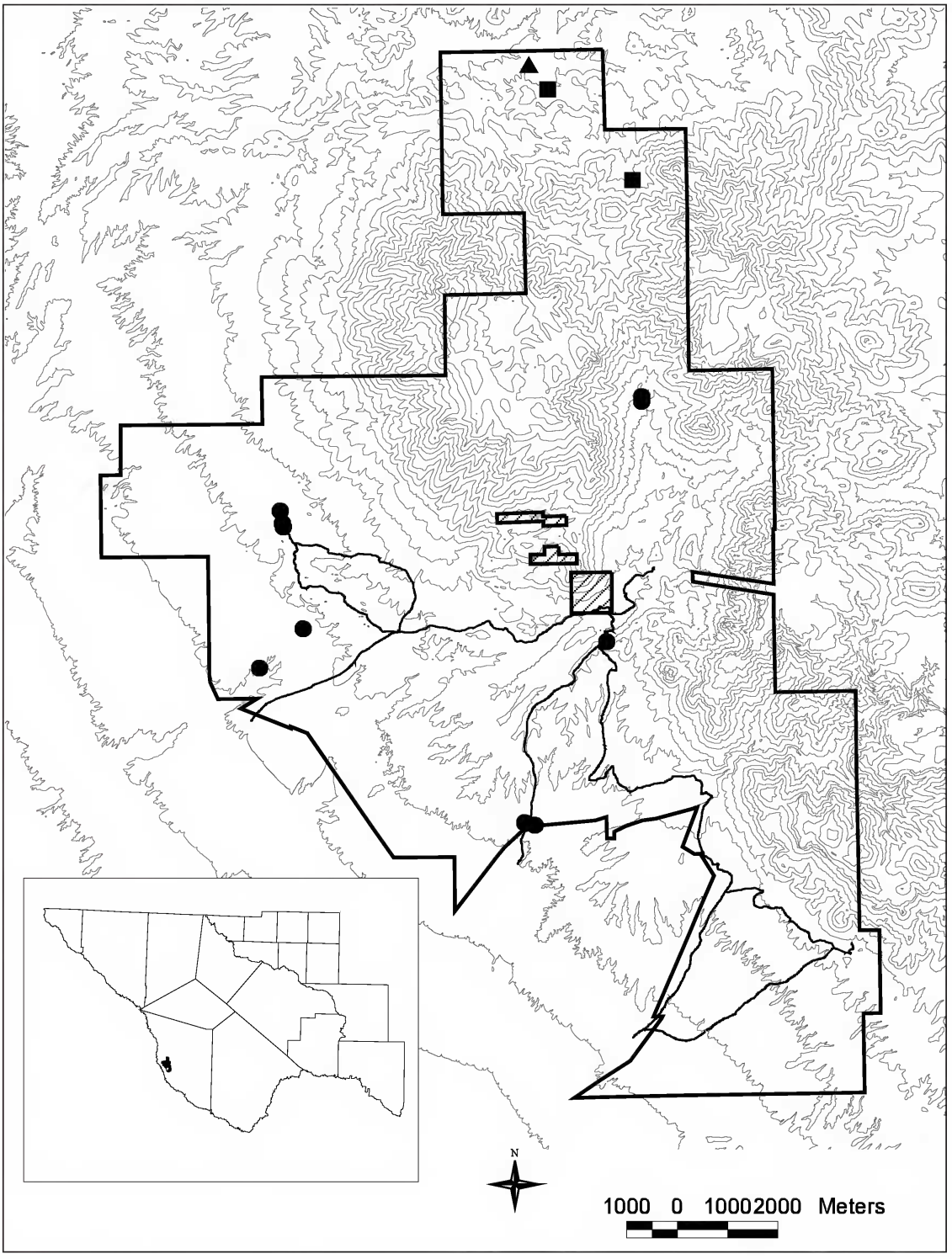

Figure 13. Locations on the CMSNA where *Peromyscus maniculatus* (circles), *Peromyscus pectoralis* (squares), or *Onychomys arenicola* (triangles) were trapped.

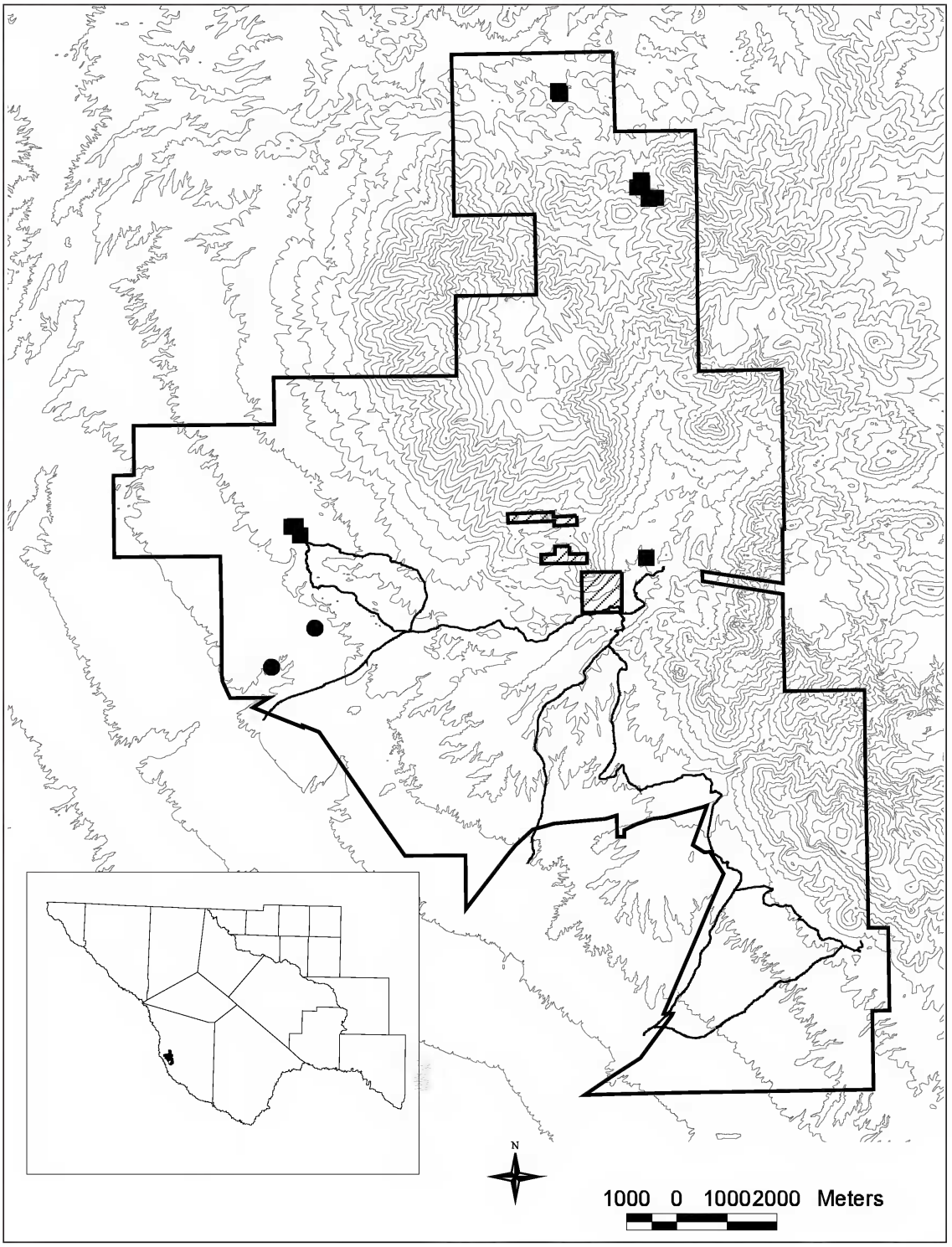

Figure 14. Locations on the CMSNA where *Sigmodon hispidus* (circles) and *Sigmodon ochrognathus* (squares) were trapped.

the CMSNA. Both specimens were taken in riparian habitat near Indian Spring and the outflow area (Fig. 14). Yancey (1997) obtained three specimens from two localities at BBRSP.

Sigmodon ochrognathus Bailey 1902
Yellow-nosed Cotton rat

This species was recorded from grassy areas at 10 places and at several elevations at the CMSNA (n = 27). However, most specimens were taken in the immediate area of La Cienega (Fig. 14). A single specimen was recorded from BBRSP (Yancey 1997).

Neotoma leucodon Merriam 1894
Eastern White-throated Woodrat

Specimens were obtained at one locality (Fig. 15) either in or adjacent to the gray oak woodlands (n = 5). This species was the most common of the woodrats at the CMSNA. This woodrat was uncommon at BBRSP (Yancey, 1997).

Neotoma mexicana Baird 1855
Mexican Woodrat

Like the previous species, this woodrat was taken at the upper elevation either in or near the gray oak woodland (Fig. 15). It seems that *N. mexicana* is relatively uncommon at the CMSNA (n = 2). *Neotoma mexicana* was listed as extremely rare at BBRSP (Yancey 1997).

Neotoma micropus Baird 1855
Southern Plains Woodrat

This species was found in the lower elevations at the CMSNA (n = 4). It seemed mostly associated with acacia, catclaw, mesquite and creosotebush habitats (Fig. 15). Yancey (1997) thought that this woodrat was relatively uncommon at BBRSP.

Erethizon dorsatum (Linnaeus 1758)
North American Porcupine

On the CMSNA, an animal was found dead on the road in the bottom of an arroyo (Fig. 16); only the skull could be salvaged. Yancey (1997) obtained no porcupines at the BBRSP.

Canis latrans Say 1823
Coyote

Presumably a single animal was heard from the porch of San Antonio Cabin at the CMSNA. Only one specimen was obtained at BBRSP (Yancey 1997), but based on sightings and calls, *C. latrans* was considered common there.

Urocyon cinereoargenteus (Schreber 1775)
Gray Fox

On the CMSNA, two animals were observed on the south rim of San Antonio Canyon. In addition, a young animal was photographed by Jim Cordes on the porch of Hilltop Cabin. A gray fox was documented at BBRSP (Yancey 1997).

Taxidea taxus (Schreber 1777)
American Badger

An animal was observed as it entered a burrow on the south side of San Antonio Canyon. It seems that this species is very rare at the CMSNA. No specimens were reported, but there was one sighting at BBRSP (Yancey 1997).

Mephitis mephitis (Schreber 1776)
Striped Skunk

An animal was observed at close range at La Cienega. In addition, odors of skunks were detected on several occasions on the CMSNA. Six striped skunks were trapped on BBRSP (Yancey 1997).

Puma concolor (Linnaeus 1771)
Mountain Lion

Large, fresh tracks were observed in the sand of the road east of San Antonio Cabin. No animals were seen on the CMSNA, but presumably they may be quite common. At BBRSP, these animals were thought to range throughout the park (Yancey 1997).

Pecari tajacu (Linnaeus 1758)
Collared Peccary

Two skulls of this species were obtained during this study. Animals also were observed frequently

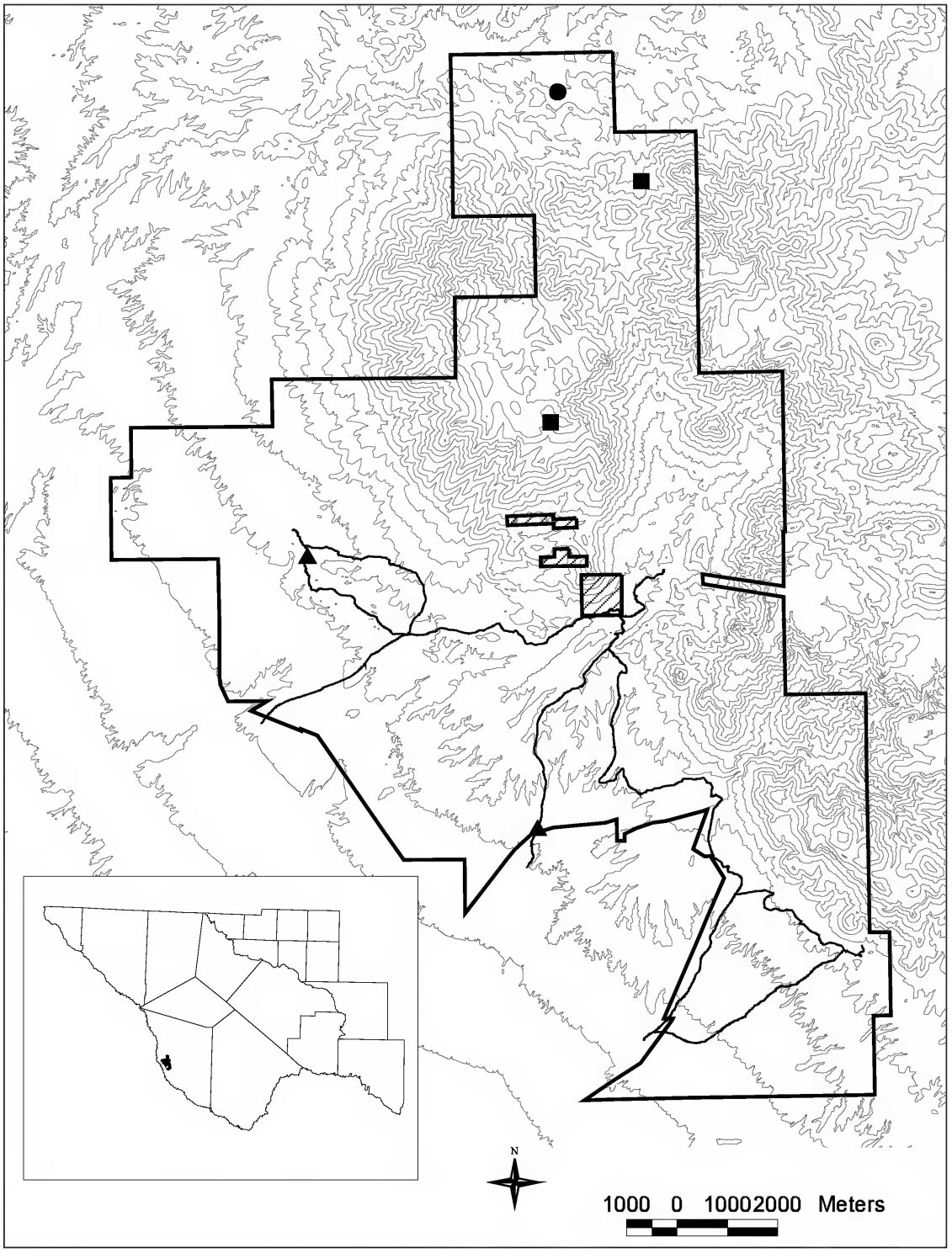

Figure 15. Locations on the CMSNA where *Neotoma leucodon* (circles), *Neotoma mexicana* (squares), and *Neotoma micropus* (triangles) were trapped.

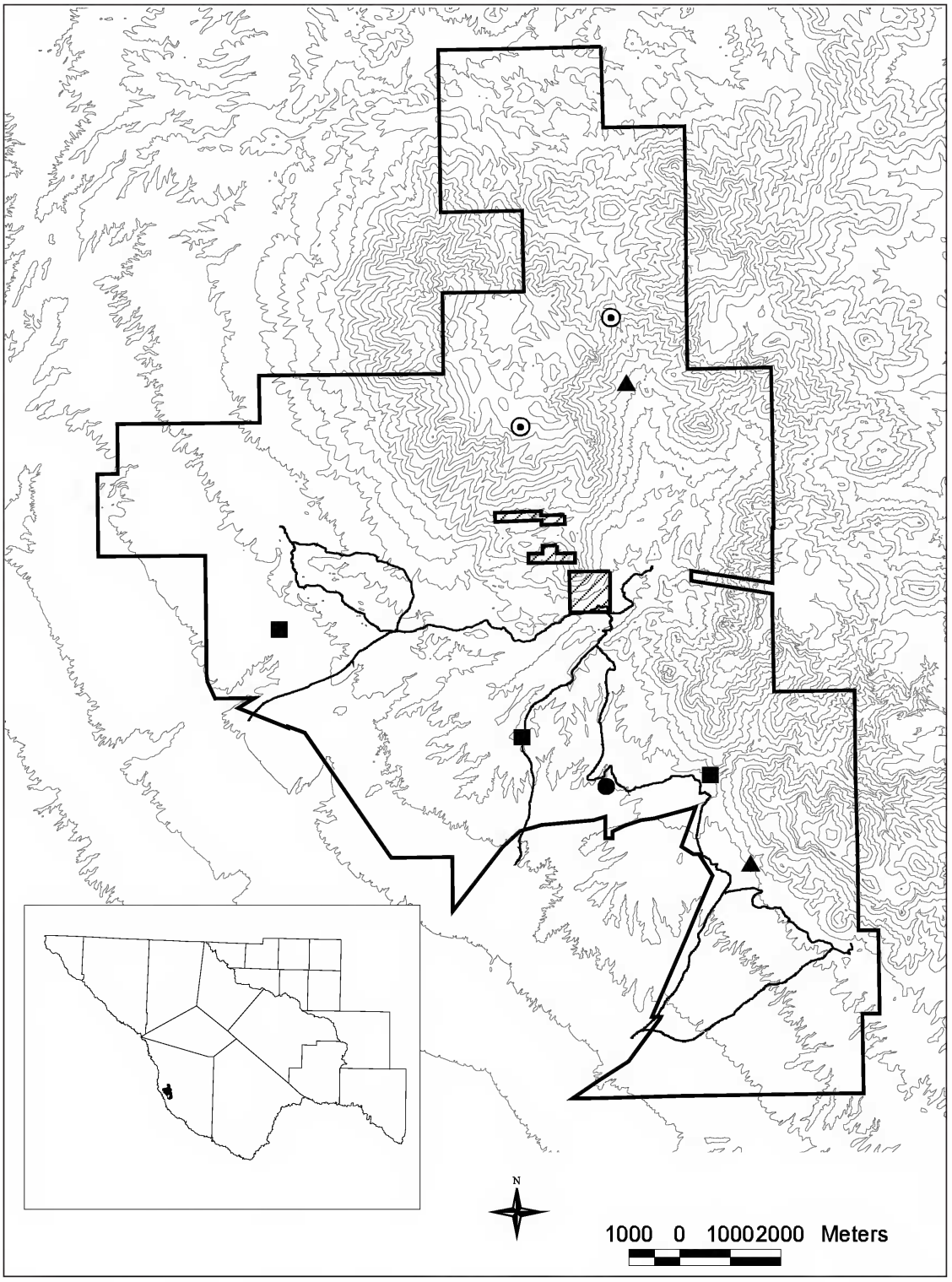

Figure 16. Locations on the CMSNA where *Erethizon dorsatum* (circles), *Pecari tajacu* (squares), *Odocoileus hemionus* (triangles), and *Odocoileus virginianus* (encircled dot) were taken or observed.

along roads (Fig. 16), and especially in arroyos at the CMSNA. Dead animals were found in and near the shack west of Hilltop Cabin. The animals were sighted frequently at BBRSP (Yancey 1997).

Odocoileus hemionus (Rafinesque 1817)
Mule Deer

One skull and two large antlers were picked up at separate places (Fig. 16) on the CMSNA. Animals were observed frequently in the vicinity of Hilltop Cabin, San Antonio Cabin, San Antonio Canyon, and lower Pelillos Arroyo. These deer occupied the limited riparian growth in the canyons and typical Chihuahuan Desert vegetation at somewhat higher elevations. They were not seen at upper elevations in oak-grasslands association. The deer at San Antonio Cabin, mostly unantlered, seemed unaware of our presence. Schmidly (2004) used the name *O. h. crooki* Mearns 1897, for these deer, however others (Kie and Czech 2000, Desmarais et al. 2000, and Wilson and Reeder 2005), have assigned these animals to *O. h. eremicus* (Mearns 1897). Yancey (1997) reported sightings of mule deer throughout BBRSP.

Odocoileus virginianus (Zimmermann 1780)
White-tailed Deer

We follow Wilson and Reeder (2005) in using *Odocoileus virginianus* (Zimmerman 1780) for this species, rather than *Odocoileus virginianus* (Boddaert 1784) as used by Schmidly (2004). An antler from an adult animal was found on the top of Sierra Parda and two partial skulls were found in upper Cinco de Mayo Canyon (Fig. 16). Sightings of these small deer were common in and adjacent to the gray oak woodlands and they were never seen at lower elevations where mule deer occurred. Based on habitat preference and the sizes of the skulls and antler, it seems that the white-tailed deer likely represent *O. v. carminis* Goldman and Kellogg 1940. We are familiar with this subspecies in the Chisos Mountains of Texas and the Maderas del Carmen Range of Coahuila, Mexico, where it is quite common. This extends the range of *O. v. carminis* approximately 90 miles to the northwest in Texas.

Ammotragus lervia
Aoudad

On the CMSNA, a small group of these animals (males, females, and young) was observed on the north end of the property. These introduced natives of North Africa may be more common in the area. Yancey (1997) reported a sighting on BBRSP.

Introduced Species.—No evidence of other introduced species was found on the CMSNA. For example, feral hogs (*Sus scrofa*) may occur along the Rio Grande, but no signs of these animals were observed on the CMSNA. There were no observations of either animals or signs of feral domestic dogs (*Canis familiaris*) or domestic cats (*Felis catus*) on the area. Perhaps of even greater importance, there was no evidence of the presence of the Norway rat (*Rattus norvegicus*), roof rat (*Rattus rattus*) and house mouse (*Mus musculus*) on the CMSNA. With the exception of *Sus scrofa*, none of the other introduced mammals were present at BBRSP (Yancey 1997).

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